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Avian Diversity and Habitat Use within the Flower Garden Banks National Marine Sanctuary

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Fauna and flora of the Flower Garden Banks National Marine Sanctuary are well documented in the literature, with few exceptions. To date, the avifauna of this marine protected area remains unreported. This paper documents the avifauna recorded opportunistically in the Sanctuary and accounts for the patterns of diversity that were observed. Land birds comprise 84% of the 50 species identified and recorded. All land birds documented in the catalogue are neotropical migrants. Transient Gulf Coast species comprise 30% of the land birds identified within the Sanctuary. Seabirds account for 16% of the species in the catalogue. The most commonly documented bird within the Sanctuary is the masked booby (*Sula dactylatra*). Two endangered species were recorded at the Flower Garden Banks. The ecological diversity of reported avifauna may be explained based on three ecological processes: seasonal migration, accidental displacement, and seasonal ranging or dispersal. Habitat use of offshore platforms is described for neotropical migrants, coastal residents, and seabirds. Future studies regarding the avifauna occurring in the northwestern Gulf of Mexico are summarily recommended.

The Flower Garden Banks National Marine Sanctuary (hereafter referred to as the Sanctuary) is known for its corals, reef fishes, and charismatic megafauna. While many fauna and flora of these banks have been reported in the literature over the past 30 yr, reports for two taxonomic groups remain glaringly absent—birds and marine mammals. Over the course of several years of fieldwork at the Sanctuary, I recorded the birds I opportunistically observed there. In this document, I interpret those records in order to elucidate the avian diversity occurring within the Sanctuary.

This paper serves to 1) report birds opportunistically observed and recorded within the Sanctuary, 2) account for the presence of reported avifauna, 3) comment on the habitat use by avifauna within the Sanctuary, and 4) propose future areas for study. Patterns of avian diversity, dynamics, and habitat use described here may be useful in the management of marine resources and in the conservation of neotropical migratory land birds, seabirds, or coastal avian residents.

THE FLOWER GARDEN BANKS NATIONAL MARINE SANCTUARY

The Sanctuary consists of three individual banks and their surrounding waters, which are situated in the northwestern Gulf of Mexico (Fig. 1). The East and West Flower Garden Banks were first protected in Jan. 1992 as a National Marine Sanctuary (National Oceanic and Atmospheric Administration, 1991) and are the northernmost tropical coral reefs on the North American continental shelf (Rezak et al., 1985). These banks occur near the continental shelf break and are classified as outer–continental shelf banks (Rezak et al., 1985). The East Flower Garden Bank (EFGB) (27°54.5′N, 093°36′W) encompasses an area of 67 km^2 and is pear shaped. It is located 198 km south of Sabine Pass on the Texas–Louisiana border. The bank reaches to within 20 m of the surface, whereas surrounding water depths are between 100 and 120 m. The West Flower Garden Bank (WFGB; 27°52.5′N, 093°48.8′W) is located 12 km west of the EFGB (Rezak et al., 1985). It includes 137 km^2, is oval in shape, and is oriented northeast–southwest. The reef crests at approximately 20 m, whereas surrounding waters are as great as 150 m deep. Total relief for the WFGB is 130 m; it is 116 m for the EFGB.

An offshore gas platform, Mobil High Island A389-A, stands on the eastern margin of the EFGB (27°54.4′N, 093°34.7′W) and is the source for many of my observations (Fig. 2). It was installed in Oct. 1981 and began production in Sept. 1988. This platform extends above the ocean's surface to a height of 23 m above sea level. Surrounding water depth is 125 m, and underwater the platform functions as an artificial reef. The main deck of the platform is 23 m by 46 m and presents considerable dry surface area in contrast to the other sites that do not broach the sea surface.

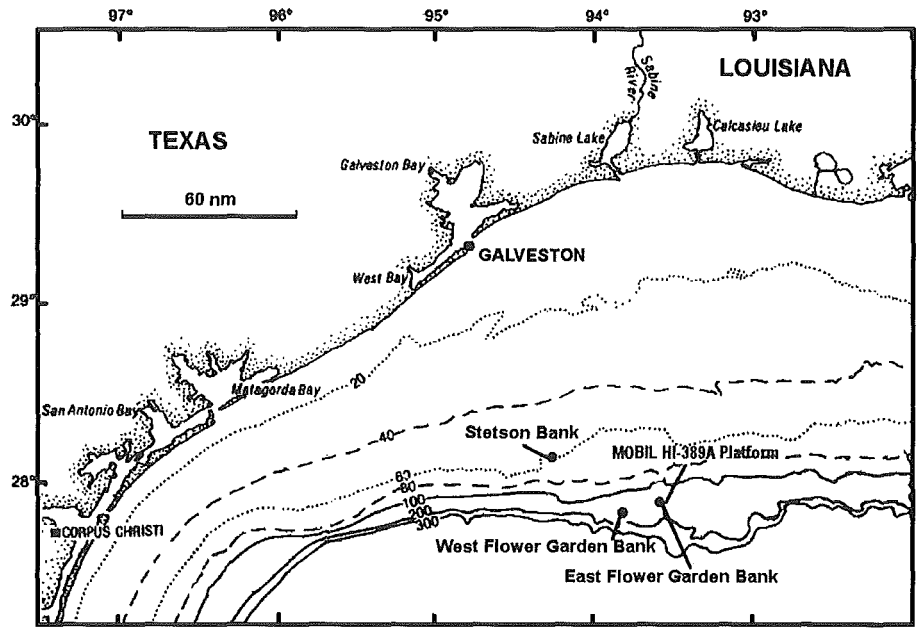

Fig. 1. Location of the Flower Garden Banks National Marine Sanctuary in relation to the Texas–Louisiana coast. After Rezak et al. (1985).

Stetson Bank (STET) is located 55 km northwest of the WFGB (28°10.0'N, 094°17'W) and is a recent addition to the Sanctuary (Oct. 1996). It rises to within 20 m of the surface and has a total relief of 40 m. Rezak et al. (1985) classified this bank as a siltstone–claystone bank with a biotic community that is dominated by fire corals and sponges. Many reef-fish species found on the EFGB or WFGB are also observed at STET.

Methods

The catalogue of bird records and anecdotal accounts of avifauna reported herein are the product of opportunistic observations made within the Sanctuary from March 1994 through May 1998. They were not part of a systematic sampling of avifauna. Figure 3 reflects the cumulative days spent at the Sanctuary during this period. Approximately 75% of the days spent in the Sanctuary were passed at the EFGB and the Mobil platform.

I made most of these observations; however, I have also included records from other reliable sources. Records were accepted from a colleague and fellow birder (Christy Pattengill), all of which included species previously documented by me in the Sanctuary. Many moribund specimens were collected on the Mobil platform, identified, and deposited at the Texas Cooperative Wildlife Collection (TCWC) at Texas A&M University, in College Station, TX. No effort was made to gather all moribund specimens available, but specimens were collected to reflect avian diversity on the Mobil platform. Only specimens deemed of good quality for identification and preservation were gathered and entered into the TCWC. Additional record sources included photographs or video that captured bird images satisfactorily enough to allow for positive identification of the birds.

All birds were identified to species level or to the next highest taxonomic level that was possible, using the techniques of the National Geographic Society (1987) and Harrison (1985). Data for each bird observed that were recorded in the catalogue include species, sex, family, order, location, date, observer, and record type (photographic, visual, capture and release, or specimen). Common and scientific nomenclature used here follow the format set forth by the American Ornithologists' Union (AOU; 1997) supplement to the *AOU Check-List of North American Birds.*

Avian diversity was examined based upon taxonomic richness as well as by assigning species to the ecological guilds defined later. Taxonomic diversity includes only those records in which birds were identified to the taxonomic level reported. Not all birds were identified to

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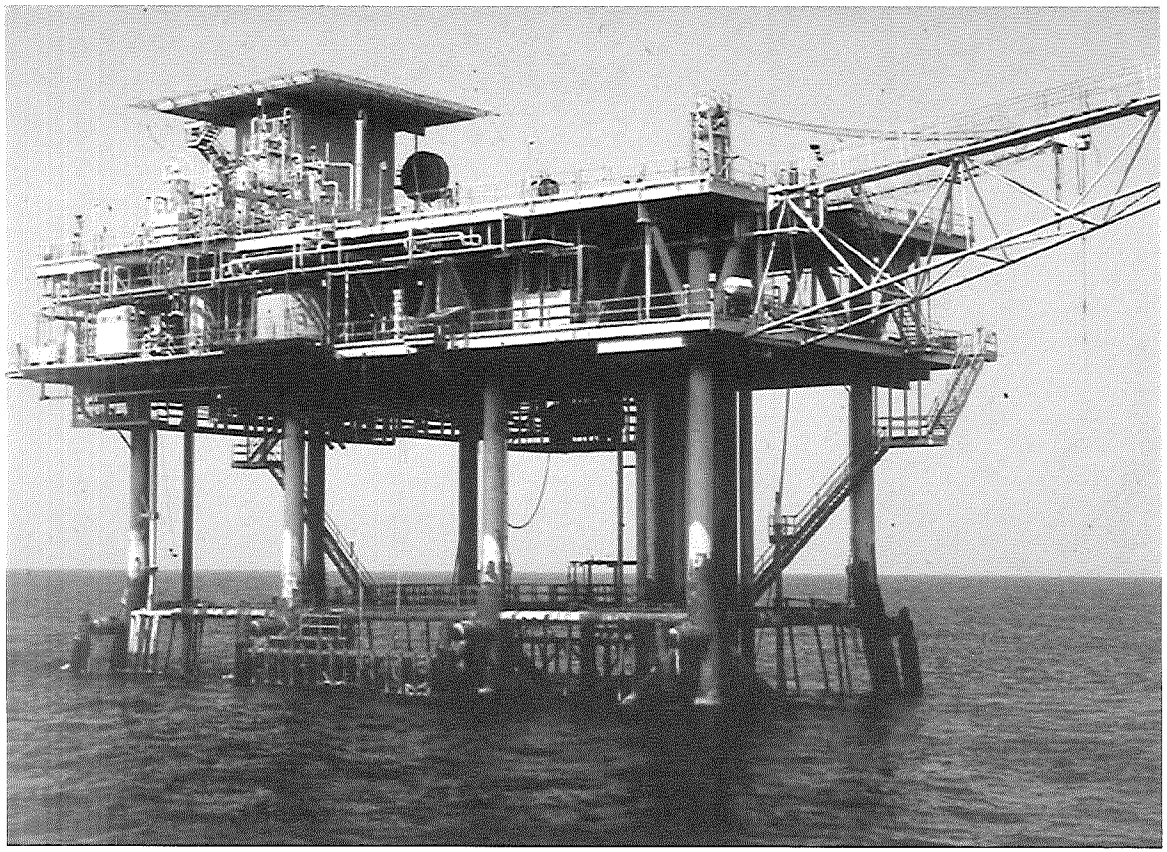

Fig. 2. The Mobil High Island A-389A offshore production platform, the only site included in this report that rises above the sea surface. The platform is located 1.5 km east of the coral cap on the East Flower Garden Bank. Photograph courtesy of Frank and Joyce Burek.

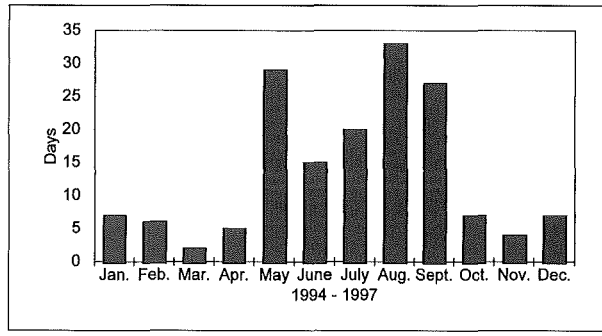

Fig. 3. Cumulative days spent offshore at the Flower Garden Banks National Marine Sanctuary. Approximately 75% of these days were spent at the East Flower Garden Bank or on the Mobil platform. Time spent at these sites was not dedicated solely to locating or identifying birds included in this report.

the species level. Ecological guilds were based upon described ecological concepts, although my definitions may vary from other researchers' definitions; however, in most cases, I followed accepted definitions.

Patterns of taxonomic and ecological avian diversity are examined and discussed in light of described ecological processes influencing the distribution of avifauna as well as in terms of the natural history of the species observed. Because of the opportunistic nature of these observations, no inferences regarding abundances of the species are reported here.

Results and Discussion

Because of the opportunistic nature of bird documentation here, the catalogue should not be interpreted as an absolute list of avifauna occurring within the Sanctuary. These records were gathered in conjunction with ichthyological studies I conducted in the Sanctuary; thus, they introduce a strong sampling bias into the catalogue. Had a systematic sampling of birds been followed, I have no doubt there would be more avian species reported here. Yet, there is considerable information to be obtained from the observed presence and behavior of birds in the Sanctuary and on offshore platforms, especially where such information has yet to be reported in the literature.

Taxonomic diversity: Orders, families, and species.— The Sanctuary is visited by a diverse assemblage of avifauna. Thirteen orders (Fig. 4) and 26 families are represented by birds occurring in the Sanctuary. Avian orders most often represented are Passeriformes (51%), Ciconiiformes and Pelecaniformes (7.5% each), and Charadriiformes and Falconiformes (5.7% each). Similarly, wood warblers (Parulidae, 15 spp.), herons (Ardeidae, 4 spp.), swallows (Hirundinidae, 3 spp.), and gulls, terns, and jaegers (Laridae, 3 spp.) are the most manifest avian families within the Sanctuary. Table 1 comprises 106 bird records reflecting 53 different taxa. Out of 50 identified species, the most frequently identified bird within the Sanctuary is the masked booby (*Sula dactylatra*). Two birds observed in the Sanctuary are listed as endangered and are federally protected under the Endangered Species Act of 1973:

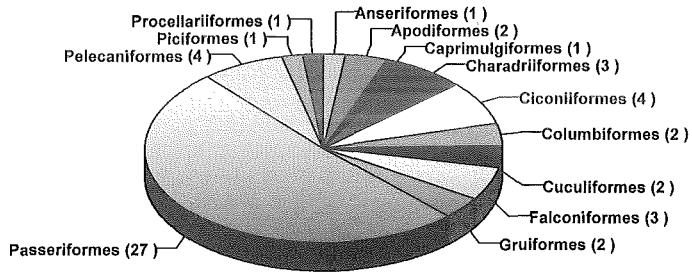

Fig. 4. Represented avian orders and taxonomic diversity for the Flower Garden Banks National Marine Sanctuary. Fifty-three birds are documented, with 50 species identified. Birds not identified to species included a sparrow, a woodpecker, and a hummingbird.

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TABLE 1. Catalogue of birds recorded within the Flower Garden Banks National Marine Sanctuary. Of the 106 records, 53 different birds were documented, with 50 species identified. Sex = unknown (u), female (f), male (m), or both (b). Bird identifications = visual (v), dead specimen (s), capture and release (c), or photograph (p).[a]

#	Order	Family	Common name	Species	Location	Date	Sex	Identification
1	Procellariiformes	Hydrobatidae	Wilson's storm petrel	*Oceanites oceanicus*	STET	05/16/95	u	v
2	Pelecaniformes	Fregatidae	Magnificent frigatebird	*Fregata magnificens*	EFGB	09/03/94	u	v
3			Magnificent frigatebird	*Fregata magnificens*	389	09/02/94	f	v
4		Sulidae	Masked booby	*Sula dactylatra*	389	08/21/95	u	v
5			Masked booby	*Sula dactylatra*	WFGB	06/21/95	u	v
6			Masked booby	*Sula dactylatra*	389	09/06/94	u	v
7			Masked booby	*Sula dactylatra*	389	09/04/94	u	v
8			Masked booby	*Sula dactylatra*	389	05/27/94	u	v
9			Masked booby	*Sula dactylatra*	EFGB	08/27/97	u	p
10			Brown booby	*Sula leucogaster*	389	05/19/98	u	v
11		Pelecanidae	Brown pelican	*Pelecanus occidentalis*	WFGB	06/14/95	u	v
12			Brown pelican	*Pelecanus occidentalis*	WFGB	06/15/95	u	v
13			Brown pelican	*Pelecanus occidentalis*	EFGB	06/15/95	u	v
14	Anseriformes	Anatidae	Blue-winged teal	*Anas discors*	389	05/17/94	m	s
15	Ciconiiformes	Ardeidae	Great egret	*Ardea alba*	389	03/31/95	u	v
16			Great blue heron	*Ardea herodias*	389	06/13/95	u	v
17			Cattle egret	*Bubulcus ibis*	389	05/27/98	u	v
18			Cattle egret	*Bubulcus ibis*	389	05/24/98	u	v
19			Cattle egret	*Bubulcus ibis*	389	05/19/98	u	v
20			Cattle egret	*Bubulcus ibis*	389	03/31/95	u	v
21			Cattle egret	*Bubulcus ibis*	389	05/27/94	u	s
22			Green heron	*Butorides striatus*	389	03/31/95	u	c
23	Falconiformes	Accipitridae	Osprey	*Pandion haliaetus*	389	03/31/95	f	v
24		Falconidae	Merlin	*Falco columbarius*	389	05/27/94	u	v
25			Peregrine falcon	*Falco peregrinus*	389	09/17/94	u	p
26	Gruiformes	Rallidae	Common moorhen	*Gallinula chloropus*	389	03/17/94	u	s
27			Purple gallinule	*Porphyrula martinica*	389	05/28/98	u	v
28	Charadriiformes	Laridae	Laughing gull	*Larus atricilla*	STET	05/20/96	u	v
29			Laughing gull	*Larus atricilla*	389	03/31/95	u	v
30			Parasitic jaeger	*Stercorarius parasiticus*	EFGB	09/03/94	u	v
31			Parasitic jaeger	*Stercorarius parasiticus*	389	08/24/94	u	v
32			Royal tern	*Sterna maxima*	EFGB	06/11/96	u	v

TABLE 1. Continued.

#	Order	Family	Common name	Species	Location	Date	Sex	Identification
33			Royal tern	*Sterna maxima*	389	04/01/95	m	v
34			Seagull sp		389	03/31/95	u	v
35			Seagull sp.		WFGB	10/14/96	u	v
36	Columbiformes	Columbidae	White-winged dove	*Zenaida asiatica*	389	05/19/98	u	p
37			White-winged dove	*Zenaida asiatica*	389	—	u	v
38			Mourning dove	*Zenaida macroura*	389	05/22/98	u	v
39			Mourning dove	*Zenaida macroura*	389	—	u	v
40	Cuculiformes	Cuculidae	Black-billed cuckoo	*Coccyzus erythropthalmus*	389	05/27/94	u	v
41			Yellow-billed cuckoo	*Coccyzus americanus*	389	05/18/98	u	v
42			Yellow-billed cuckoo	*Coccyzus americanus*	389	08/13/97	u	v
43	Caprimulgiformes	Caprimulgidae	Common nighthawk	*Chordeiles minor*	389	05/27/98	m	v
44			Nighthawk sp.		389	09/16/95	f	v
45	Apodiformes	Apodidae	Chimney swift	*Chaetura pelagica*	389	05/28/94	u	s
46		Trochilidae	Hummingbird sp.		EFGB	08/95	u	v
47	Piciformes	Picidae	Woodpecker sp.		389	—	u	v
48	Passeriformes	Tyrannidae	Eastern phoebe	*Sayornis phoebe*	389	05/21/98	u	s
49			Eastern phoebe	*Sayornis phoebe*	389	05/20/98	u	v
50		Vireonidae	Red-eyed vireo	*Vireo olivaceus*	389	05/02/95	u	s
51			Red-eyed vireo	*Vireo olivaceus*	389	09/03/94	u	v
52		Turdidae	Swainson's thrush	*Catharus ustulatus*	389	04/17/94	u	s
53		Mimidae	Gray catbird	*Dumetella carolinensis*	389	05/02/95	u	s
54			Gray catbird	*Dumetella carolinensis*	389	04/17/94	u	s
55		Hirundinidae	Cliff swallow	*Hirundo pyrrhonota*	389	05/20/98	u	v
56			Barn swallow	*Hirundo rustica*	WFGB	09/08/97	u	v
57			Bank swallow	*Riparia riparia*	389	05/18/98	u	v
58			Bank swallow	*Riparia riparia*	WFGB	09/08/97	u	v
59			Swallow sp.		WFGB	07/12/96	u	v
60			Swallow sp.		389	03/31/95	u	v
61		Parulidae	Bay-breasted warbler	*Dendroica castanea*	STET	05/13/97	m	v
62			Bay-breasted warbler	*Dendroica castanea*	389	05/02/95	m	s
63			Bay-breasted warbler	*Dendroica castanea*	389	05/02/95	u	s
64			Bay-breasted warbler	*Dendroica castanea*	389	05/02/95	f	s
65			Bay-breasted warbler	*Dendroica castanea*	389	04/17/94	f	s
66			Yellow-rumped warbler	*Dendroica coronata*	FGB	—	m	v
67			Yellow-throated warbler	*Dendroica dominica*	389	04/17/94	u	s
68			Magnolia warbler	*Dendroica magnolia*	389	05/18/98	m	v

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TABLE 1. Continued.

#	Order	Family	Common name	Species	Location	Date	Sex	Identification
69			Magnolia warbler	*Dendroica magnolia*	389	05/17/98	m	v
70			Magnolia warbler	*Dendroica magnolia*	STET	05/13/97	m	s
71			Magnolia warbler	*Dendroica magnolia*	389	05/02/95	m	s
72			Magnolia warbler	*Dendroica magnolia*	389	05/02/95	f	s
73			Magnolia warbler	*Dendroica magnolia*	389	04/17/94	m	s
74			Chestnut-sided warbler	*Dendroica pensylvanica*	STET	05/13/97	b	v
75			Chestnut-sided warbler	*Dendroica pensylvanica*	389	05/02/95	m	s
76			Yellow warbler	*Dendroica petechia*	STET	05/13/97	f	v
77			Pine warbler	*Dendroica pinus*	389	09/02/94	m	c
78			Black-throated green warbler	*Dendroica virens*	389	05/02/95	f	s
79			Black-throated green warbler	*Dendroica virens*	389	04/17/94	u	s
80			Common yellowthroat	*Geothlypis trichas*	WFGB	09/11/97	f	c
81			Common yellowthroat	*Geothlypis trichas*	389	05/02/95	f	s
82			Common yellowthroat	*Geothlypis trichas*	389	05/02/95	m	s
83			Black and white warbler	*Mniotilta varia*	389	05/02/95	f	s
84			Black and white warbler	*Mniotilta varia*	389	05/02/95	m	s
85			Black and white warbler	*Mniotilta varia*	389	04/17/94	u	s
86			Kentucky warbler	*Oporornis formosus*	389	05/02/95	f	s
87			Kentucky warbler	*Oporornis formosus*	389	04/17/94	u	s
88			Northern parula	*Parula americana*	389	05/02/95	u	s
89			Northern parula	*Parula americana*	389	04/17/94	b	s
90			Ovenbird	*Seiurus aurocapillus*	389	05/18/98	u	v
91			Ovenbird	*Seiurus aurocapillus*	STET	05/13/97	u	s
92			Ovenbird	*Seiurus aurocapillus*	389	05/02/95	f	s
93			Ovenbird	*Seiurus aurocapillus*	389	04/17/94	u	s
94			American redstart	*Setophaga ruticilla*	STET	05/13/97	f	v
95			American redstart	*Setophaga ruticilla*	389	05/02/95	m	s
96			American redstart	*Setophaga ruticilla*	389	04/17/94	m	s
97			Hooded warbler	*Wilsonia citrina*	389	05/02/95	m	s
98			Hooded warbler	*Wilsonia citrina*	389	05/02/95	f	s
99		Thraupidae	Scarlet tanager	*Piranga olivacea*	389	05/20/98	f	v
100			Scarlet tanager	*Piranga olivacea*	389	04/17/94	m	s
101			Summer tanager	*Piranga rubra*	389	05/02/95	f	s
102			Summer tanager	*Piranga rubra*	389	04/17/94	m	s

TABLE 1. Continued.

#	Order	Family	Common name	Species	Location	Date	Sex	Identification
103		Cardinalidae	Indigo bunting	*Passerina cyanea*	389	05/02/95	m	s
104			Indigo bunting	*Passerina cyanea*	389	04/17/94	m	s
105		Emberizidae	Sparrow sp.		WFGB	—	u	v
106		Icteridae	Orchard oriole	Icterus spurius	389	10/14/96	m	v

[a] STET = Stetson Bank; EFGB = East Flower Garden Bank; 389 = Mobil High-Island A-389A offshore production platform; WFGB = West Flower Garden Bank; FGB = Flower Garden Banks.

the Peregrine falcon (*Falco peregrinus*) and the brown pelican (*Pelecanus occidentalis*).

Ecological diversity: Macrohabitat association.—Initially, birds were grouped by their macrohabitat associations (land or sea birds). Harrison (1985) defines seabirds as those avian species whose normal habitat and food source are the sea, whether they be coastal, offshore, or pelagic. Species are grouped, based upon their known spatial ecology (movements, biogeographic ranges, and habitat use), in Table 2. All land birds observed at the Sanctuary are known neotropical migrants. Neotropical migratory birds are those Western Hemisphere avian species, all or part of whose populations breed north of the Tropic of Cancer and that winter south of that line (Rappole et al., 1983). Range maps from DeGraaf and Rappole (1995) were used in part in the assignment of land birds to this migratory guild.

While many of the birds observed in the Sanctuary are known to reside seasonally along the northwestern Gulf Coast, 11 species (26%) of the neotropical migratory land birds observed in the Sanctuary are transient Gulf Coast species (Table 2). Lowery (1945) defined this guild as containing those avian species that visit yet do not breed along the Gulf Coast or in the extreme lower Mississippi Valley. These birds are visitors to the Gulf Coast during their annual migrations between winter habitat in the tropics and breeding areas north of the Gulf coastal plain.

During migrations between winter habitat and breeding areas in the Americas, neotropical migratory land birds often cross the Gulf of Mexico (see Lowery, 1946; Bullis and Lincoln, 1952; Paynter, 1953; Bullis, 1954; Siebenaler, 1954; Stevenson, 1957; Gauthreaux, 1971; Able, 1972; or Moore et al., 1990, for additional information on this previously contested concept). At the same time, there are species and populations that take a more circuitous route, following the land bridge formed to the west by Mexico or to the east by the Florida peninsula and Caribbean islands such as Cuba and the West Indies. Preferred routes of neotropical migratory land bird populations over or around the Gulf of Mexico are ambiguous. Stevenson (1957) examined the phenomenon of trans-Gulf and circum-Gulf migrations, based on direct observations, comparative abundances of birds around the Gulf in spring, and the sequence of spring arrival dates. His study elucidates the migratory corridors chosen between winter and breeding areas for some neotropical migratory land birds with re-

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TABLE 2. Avian Ecological Guilds based upon movement and migration patterns in relation to the northwestern Gulf of Mexico. The migratory corridor reflects known routes taken by neotropical migratory land birds found in Stevenson (1957) or, in the case of transequatorial migratory seabirds, the migratory pattern they follow with respect to their breeding area (Harrison, 1985). Corridors were not specified for those birds that were not identified to the species level. Species that visit the northwestern Gulf Coast only during their seasonal migrations between wintering areas in the neotropics and breeding areas in the Nearctic (transient species) are denoted with (T) in the guilds column.

Guilds	Family	Common name	Species	Migratory corridor
Neotropical migratory land birds				
	Anatidae	Blue-winged teal	*Anas discors*	Circum-Gulf
	Ardeidae	Cattle egret	*Bubulcus ibis*	Unknown
		Great blue heron	*Ardea herodias*	Trans-Gulf
		Great egret	*Ardea alba*	Unknown
		Green heron	*Butorides striatus*	Trans-Gulf
	Accipitridae	Osprey	*Pandion haliaetus*	Both
	Falconidae	Merlin	*Falco columbarius*	Unknown
		Peregrine falcon	*Falco peregrinus*	Trans-Gulf
	Rallidae	Common moorhen	*Gallinula chloropus*	Unknown
		Purple gallinule	*Porphyrula martinica*	Both
	Columbidae	Mourning dove	*Zenaida macroura*	Trans-Gulf
		White-winged dove	*Zenaida asiatica*	Unknown
T	Cuculidae	Black-billed cuckoo	*Coccyzus erythropthalmus*	Trans-Gulf
		Yellow-billed cuckoo	*Coccyzus americanus*	Trans-Gulf
	Caprimulgidae	Common nighthawk	*Chordeiles minor*	Trans-Gulf
	Apodidae	Chimney swift	*Chaetura pelagica*	Both
	Trochilidae	Hummingbird sp.		
	Picidae	Woodpecker sp.		
	Tyrannidae	Eastern phoebe	*Sayornis phoebe*	Trans-Gulf
	Vireonidae	Red-eyed vireo	*Vireo olivaceus*	Trans-Gulf
T	Turdidae	Swainson's thrush	*Catharus ustulatus*	Unknown
	Mimidae	Gray catbird	*Dumetella carolinensis*	Trans-Gulf
	Hirundinidae	Bank swallow	*Riparia riparia*	Trans-Gulf
		Barn swallow	*Hirundo rustica*	Trans-Gulf
T	Parulidae	American redstart	*Setophaga ruticilla*	Both
T		Bay-breasted warbler	*Dendroica castanea*	Trans-Gulf
		Black and white warbler	*Mniotilta varia*	Both
T		Black-throated green warbler	*Dendroica virens*	Both
T		Chestnut-sided warbler	*Dendroica pensylvanica*	Trans-Gulf
		Common yellowthroat	*Geothlypis trichas*	Both
		Hooded warbler	*Wilsonia citrina*	Trans-Gulf
T		Kentucky warbler	*Oporornis formosus*	Trans-Gulf
T		Magnolia warbler	*Dendroica magnolia*	Trans-Gulf
		Northern parula	*Parula americana*	Both
		Ovenbird	*Seiurus aurocapillus*	Trans-Gulf
		Pine warbler	*Dendroica pinus*	Unknown
T		Yellow warbler	*Dendroica petechia*	Trans-Gulf
		Yellow-rumped warbler	*Dendroica coronata*	Both
		Yellow-throated warbler	*Dendroica dominica*	Both
T	Thraupidae	Scarlet tanager	*Piranga olivacea*	Both
		Summer tanager	*Piranga rubra*	Both
T	Cardinalidae	Indigo bunting	*Passerina cyanea*	Trans-Gulf
	Emberizidae	Sparrow sp.		
	Icteridae	Orchard oriole	*Icterus spurius*	Trans-Gulf
Transequatorial migratory seabirds				
	Hydrobatidae	Wilson's storm petrel	*Oceanites oceanicus*	Circum-Austral
	Laridae	Parasitic jaeger	*Stercorarius parasiticus*	Circum-Boreal

TABLE 2. Continued.

Guilds	Family	Common name	Species	Migratory corridor
Neotropical seabirds				
	Fregatidae	Magnificent frigatebird	*Fregata magnificens*	—
	Sulidae	Masked booby	*Sula dactylatra*	—
		Brown booby	*Sula leucogaster*	—
Gulf Coast residential seabirds				
	Pelecanidae	Brown pelican	*Pelecanus occidentalis*	—
	Laridae	Laughing gull	*Larus atricilla*	—
		Royal tern	*Sterna maxima*	—

spect to the Gulf of Mexico. I compared the birds recorded in the Sanctuary with Stevenson's findings. Thirty-four of the bird species recorded are known trans-Gulf migrants, and 14 species are known circum-Gulf migrants. Where these guilds are not mutually exclusive, 13 species are known to follow either route. Stevenson did not list seven of the species observed as either trans-Gulf or circum-Gulf migrants (Table 2).

Although the migratory corridors of many populations remain vague, we know that some populations follow a circum-Gulf route, whereas others conduct trans-Gulf migrations. The location of the Sanctuary easily lies within the migratory corridor of species crossing the western Gulf of Mexico. While the circum-Gulf migratory corridor has yet to be effectively delimited, Williams (1950b) depicted a circum-Gulf migratory corridor as an inverted triangle, expanding from Mexico into Texas and northward and shifting eastward over the Gulf of Mexico at times, depending on meteorological factors in the region. If this is the case, then the Sanctuary may lie at times on the eastern margin of the circum-Gulf corridor (under favorable weather conditions). These migratory corridors place many neotropical migratory land birds over or near the Sanctuary at predictable times during any year.

Seabirds: Seabirds were also grouped according to their spatial ecology and natural history. Ecological diversity was represented by three guilds: transequatorial migratory seabirds, neotropical seabirds, and northwestern Gulf Coast residential seabirds.

Transequatorial migratory seabirds are seabird species that winter in one hemisphere and breed in the other hemisphere. Although this guild includes a wide spectrum of seabirds, two species occurring in the Sanctuary mirror an interesting migratory model. The parasitic jaeger (*Stercorarius parasiticus*) and Wilson's storm petrel (*Oceanites oceanicus*) breed in opposite polar regions and may occur in the Gulf of Mexico during their respective winter seasons (Harrison, 1985). Wilson's storm petrel winters in the Gulf of Mexico and northern Atlantic Ocean from April to Sept. and breeds during the austral summer on lands adjacent to the Southern Ocean (Harrison, 1985). This species is considered by many to be the most common seabird in the world (Nelson, 1979). The parasitic jaeger, a boreal breeder, forages in the Gulf of Mexico and throughout the Atlantic Ocean during the northern winter months (Harrison, 1985). Yet, nonbreeding parasitic jaegers may occur much earlier, as they depart from the boreal breeding areas for their winter habitat as early as July. Jaegers observed at the Flower Garden Banks were young birds, as indicated by their plumage. Parasitic jaegers may be confused with Pomarine jaegers (*Stercorarius pomarinus*), particularly as young birds. However, based upon my observations, the jaegers I observed on two occasions in the Sanctuary were best identified as parasitic jaegers. Both species are known to occur in the area (Fritts et al., 1983), although Pomarine jaegers are thought by some to be more common in the western Gulf and parasitic jaegers more common off the coast of Alabama (Duncan and Havard, 1980).

Neotropical seabirds (avian species native to the marine habitats between the Tropics of Cancer and Capricorn in the New World) observed at the Sanctuary include the masked booby, the brown booby (*S. leucogaster*), and the magnificent frigatebird (*Fregata magnificens*). Neotropical seabirds often range from tropical waters during warmer months, extending their foraging habitats to include the productive waters of the northern Gulf of Mexico (Clapp et al., 1982; Fritts et al., 1983). Brown boobies observed in the northern Gulf are

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thought to range from Campeche Bank, off the Mexican Yucatan (Clapp et al., 1982). Oberholser (1974) considers them to be uncommon along the northwestern Gulf Coast. Both the magnificent frigatebird and the masked booby maintain breeding colonies in the southeastern Gulf of Mexico, off Florida, and farther south into the Caribbean region (Harrison, 1985). Aerial surveys conducted by Fritts et al. (1983) showed magnificent frigatebirds as far as 165 km from the Gulf Coast.

Gulf Coast residential seabirds occur yearround in the northwestern Gulf of Mexico region and maintain breeding colonies along the Gulf Coast. There were numerous sightings of gulls and terns at the Sanctuary, yet only two species were identified: the laughing gull (*Laurus atricillia*) and the royal tern (*Sterna maxima*). Fritts et al. (1983) noted that royal terns and laughing gulls were rarely observed over offshore or pelagic waters but were most likely to be seen in coastal waters. Based upon aerial surveys conducted by Fritts et al., royal terns were observed over deep water in April, June, and Aug. off the Texas coast. In the same study, laughing gulls were recorded closest to the Texas coast during the summer months and farthest from the Texas coast (96.9 km) in Feb. Another coastal resident, the brown pelican, was observed at both Flower Garden Banks and is discussed in the next section.

Habitat use.—Birds within the Sanctuary were observed flying, foraging, resting, roosting, or refuging. Platforms used as resting or roosting sites included boats, buoys, and the Mobil platform. The Mobil platform provided a considerable number of sites for resting, roosting, and refuging from human activity or inclement weather. Coastal seabirds were occasionally found resting on the sea surface. Foraging activity was evident among both land and sea birds. Passerines, caprimulgids, and raptors were observed foraging either on or from the Mobil platform or boats. Frigatebirds, jaegers, storm petrels, boobies, gulls, and terns were observed foraging in the waters over the submerged banks or around the Mobil platform.

Resting or roosting land birds were observed resting primarily on the Mobil platform (during either day or night), which provides considerable structure for perching. Birds were found settled on all levels of the platform, from the helicopter pad (top level) to the catwalk located several meters above sea level. Swallows and other aerial specialists were often observed roosting on the communications tower or on various cables strung about the platform. In many cases, land birds sought protected or shaded areas, away from human activity, or areas where birds could easily take flight. Birds were also observed resting or roosting on boats moored over one of the submerged banks, but these birds were often disturbed by shipboard activity. Many land birds resting on boats were visibly tired and easily approached by people. As on the Mobil platform, these birds often sought areas on the boat that were shaded and that offered some protection. Mooring buoys used by vessels visiting the Flower Garden Banks were also used for resting places by smaller passerines. On several occasions, I observed a hummingbird or wood warbler resting briefly on a mooring buoy or Zodiac boat at the EFGB.

On two occasions, a falcon was observed roosting on the Mobil platform. A Peregrine falcon and a merlin (*Falco columbarius*) were observed on separate occasions, hunting approaching passerines from the platform. Each hunting attempt observed was successful, and the falcons returned to consume their prey at the Mobil platform. Passerines taken in these hunting forays were lone individuals approaching the platform during daylight. Thus, offshore oil or gas platforms serve as hunting perches for migrating raptors, and passerines crossing the Gulf of Mexico may be considered available food resources for these birds.

Raptor predation on migrating passerines and shorebirds at terrestrial stop-over areas has been reported by Page and Whitacre (1975), Whitacre (1985), Lindstrom (1989), Kerlinger (1989), and Moore et al. (1990), yet it has been poorly documented on offshore platforms (Merrie, 1979). Merlins, Peregrine falcons, and ospreys (*Pandion haliaetus*) have all been reported several hundred kilometers offshore on platforms in the North Sea (Anderson, 1985). Kerlinger (1989) considers water crossings of over 100 km by raptors to be rare, yet such crossings are performed by falcons more than they are by other raptors. Peregrine falcons are known to occur off the East coast of the United States (Cochran, 1985), and both Peregrine falcons and ospreys have been observed foraging at sea (Rogers and Leatherwood, 1981).

Passerines were observed foraging while on dive boats or the Mobil platform. Alert birds were quick to consume various insects that also settled on the platforms. It was apparent that winds transported many insects to the platform, and on several occasions, large numbers of dragonflies were observed roosting overnight on the Mobil platform. I observed pas-

serines foraging on moths, butterflies, flies, beetles, bees, and other unidentified flying insects. While some butterflies are known to be toxic, this is not known to be true of all species. Based upon my 20 yr of experience working offshore, insects are uncommon (in both abundance and diversity) over the surface waters of the outer continental shelf, relative to coastal terrestrial habitats. Considering the physiological demands that trans-Gulf migrants experience, sources of energy are greatly needed by individual birds. Land birds faced with starvation and exhaustion midway through a trans-Gulf migration may not be as selective in terms of available insect prey as they might typically be in their terrestrial habitats, where there is a much more broad menu from which to choose.

Many passerines were quick to take advantage of the freshwater available on the Mobil platform or on boats visiting the banks. Freshwater would pool on the deck of the Mobil platform in certain areas after diving equipment and inflatable boats were rinsed each evening or after rain squalls or storms passed over the platform. While freshwater was not readily accessible to birds on dive boats, people would often set out dishes of freshwater for nearby roosting birds, who took advantage of the handout. In some cases, birds appeared too tired to move and were provided with sugar water; in time, these birds exhibited increased levels of alertness and activity.

Roosting behavior among the observed land birds was associated primarily with migrations or refuging from inclement weather. Many neotropical migratory land birds would "fallout" to the Mobil platform when encountering opposing winds or heavy rains in the area during migratory periods. Previously, researchers have noted similar fallout behavior, occurring primarily on the coast but also on ships, exposed reefs, and offshore platforms (Lowery, 1945; Williams, 1950a; Gauthreaux, 1971; Buskirk, 1980; Gauthreaux, 1996). Gauthreaux (1971) noted that considerable numbers of neotropical migratory birds fallout on platforms along the Louisiana coast when confronted with an advancing northern front. Many of these birds die as a result of starvation. Some neotropical migratory land birds died on the Mobil platform, probably because of exhaustion or of the starvation associated with the rigors of migration. However, many birds were observed to depart northward from the platform as weather conditions improved, and they probably continued their migration. For example, several heron species were observed roosting on the platform in late March and June with many other neotropical migrants. These birds were perched on the platform during the evening but were absent the following morning and are thought to have continued their migration to the northern Gulf Coast. Stevenson (1957) lists four species of herons that conduct trans-Gulf migrations and six heron species that conduct circum-Gulf migrations.

It is possible that birds observed roosting on the platform at night and missing the following morning could have died and fallen from the platform into the sea. This probably happens; however, I strongly doubt this to be the case for many birds roosting on the platform. Herons were observed roosting well within the perimeter of the Mobil platform on either of the main equipment decks. Many passerines were also observed roosting on or under equipment in this area during inclement weather. Some moribund individuals were found in these areas; however, they were not found near the quantities of active birds observed earlier. Other land birds found refuge below the cellar deck on piping, catwalks, or structural lips of one sort or other. Birds succumbing to exhaustion or starvation while roosting below the cellar deck are likely to be those birds that fall from the platform into the sea.

Refuging from inclement weather was not restricted to migratory populations. On occasion during the summer months, land birds would arrive at the platform, presages to an ominous storm front that was bearing down on the area from the northwest. On two occasions in the early summer, I observed herons approaching the platform from the northwest as inclement weather advanced from the same direction. These birds sought refuge on the platform and were gone the following morning in clear weather. Herons were observed flying ahead of approaching storms from the Texas coast in early summer and were evidently evading inclement weather that had likely driven them from their coastal habitats. Advancing storms may accidentally displace coastal birds, driving them out into the Gulf of Mexico and at times placing them in the vicinity of the Flower Garden Banks. These birds may "platform hop" between offshore platforms as they attempt to seek refuge from advancing inclement weather or may later attempt to return to their normal terrestrial habitats.

Land birds were also observed using the Mobil platform in good weather. The Peregrine falcon and the merlin were each observed at the platform on days with clear and pleasant

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weather. Swallows, hummingbirds, cuckoos, wood warblers, a nighthawk, and a woodpecker were all observed on the Mobil platform during good weather. However, such habitat use of the Mobil platform among these birds was clearly associated with trans-Gulf migrations. Thus, neotropical migratory land birds used the platform for resting and roosting in good and poor weather.

The presence of the lone pine warbler (*Dendroica pinus*) at the Sanctuary is not easily explained. This adult male was observed on the platform in early Sept., a period during which some warblers migrate across the Gulf of Mexico (DeGraaf and Rappole, 1995). The pine warbler is not known to winter south of the northern Gulf Coast. Several possibilities exist to explain the occurrence of this bird. This species (although as yet undocumented) may actually conduct trans-Gulf migrations to Central America, though I believe that this is very unlikely. The bird may have been accidentally displaced with an advancing northern front and may have become disoriented, moving farther out into the Gulf by platform hopping. It is also possible that the bird "overflew" its winter habitat area on its migration from breeding areas in the north. Examples of vagrant or accidental occurrences among avifauna is not uncommon in the literature. Finally, I may have misidentified this bird; however, I consider this possibility unlikely, since I held this bird and identified it from a field guide. I do not know what became of this individual, since it was not seen later in the day on the platform.

Gulf waters serve as a seasonal foraging habitat to seabird species documented at the Sanctuary. Both transequatorial migratory seabirds reported use the region as a winter feeding habitat. Two observations of juvenile parasitic jaegers at the EFGB in late summer support reports of juvenile habitat use in the northwestern Gulf during this period. For each observation of a jaeger or storm petrel that was recorded, foraging behavior was conspicuous. Neither species was observed roosting on any available platforms (buoy, boat, or offshore platform). Seasonal migrations and nomadic foraging expeditions may at times place the birds within the boundaries of the Sanctuary. These birds may then take advantage of fish aggregations occurring over the submerged banks or around the artificial reef created by the Mobil platform.

Likewise, neotropical seabirds were observed foraging in the waters over the Sanctuary. On one occasion at the EFGB, a magnificent frigatebird and parasitic jaeger were observed pirating a fish from one another. Fritts et al. (1983) also observed a similar interaction between these two species in the Gulf of Mexico. Masked boobies, the most commonly identified species in the Sanctuary, were observed foraging in waters over the submerged banks. On several occasions, boobies flew over the Mobil platform but did not settle on it. On another occasion, a lone masked booby was observed resting on the helicopter pad of the Mobil platform over the course of an afternoon, and by mid-evening, it had departed. Ortego (1977, 1978) observed boobies foraging close to an offshore platform within the Flower Garden Banks region. He suggested that boobies forage close to platforms where many fishes concentrate around the underwater structure. Additionally, he suggested that boobies probably roost on offshore platforms; however, he did not indicate that he had observed such behavior (Ortego, 1978).

Gulls and terns were observed at the Sanctuary; however, they were often not identified to the species level or recorded, in part because of my other activities at the time of observation. Foraging and resting behavior were often apparent among the larids observed. On several occasions, terns were observed resting on the gas flume extending out from the Mobil platform. Many gull and tern species are northern Gulf coastal residents, and their habitat use of offshore waters is seasonal (Fritts et al., 1983). Gulls and terns were periodically observed during a year in any one of the Sanctuary sites, often foraging along drift-rows of *Sargassum* spp. or flotsam.

Another northern Gulf coastal resident observed at the Flower Garden Banks, albeit an unexpected one, was a brown pelican. The normally coastal bird followed a dive charter boat that was moving into the WFGB. As the boat moored there, the pelican settled down in the water nearby. Later in the day, the boat moved to the EFGB, and the pelican followed. The National Oceanic and Atmospheric Administration R/V *Ferrel* and another charter dive vessel of similar size were also present at the bank. The bird settled on the water and remained until the following morning, when both charter dive vessels departed. The pelican flew above the dive boats, which were headed back to Freeport, TX. At no point was the pelican observed foraging naturally or roosting on a platform. Pelicans, gulls, and terns frequently follow shrimp boats and other fishery vessels, taking advantage of bycatch dumped back into the sea. Fritts et al. (1983) noted that most brown pelicans in their study occurred within

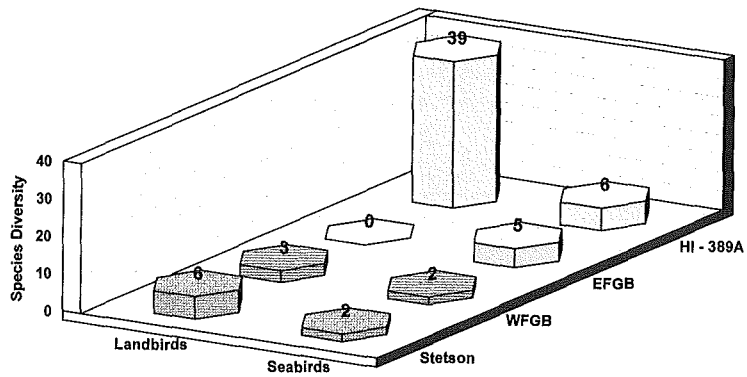

Fig. 5. Avian species diversity per site within the Flower Garden Banks National Marine Sanctuary. Sites are listed from west to east. Note the decreasing land bird species and increasing seabird species reported for the more seaward and easterly sites. The exception to this pattern is the Mobil High-Island A-389A platform, where most land birds were observed within the Sanctuary.

2 km of the coast, while one brown pelican was found 99 km offshore of the western coast of Florida. The Flower Gardens pelican probably strayed from local coastal waters, possibly while foraging behind a fishing vessel, and followed the dive boats with the anticipation of food or anticipating that one boat might lead it back to its familiar habitat again. Under the circumstances, such occurrences may be the result of accidental displacement, albeit for reasons different than those associated with accidentally displaced land bird species that are refuging from inclement weather systems originating over the North American continent.

Diversity between sites.—Figure 5 illustrates avian species diversity per site within the Sanctuary. Five species were recorded at each Flower Garden Bank and eight species were recorded at STET. Forty-five species (90%) occurred on the Mobil platform. As expected, sites closer to the coast (westerly sites relative to one another) had more land bird species and fewer seabirds than did easterly sites farther from the coast, excluding the Mobil platform. Noteworthy is the seasonal use of the Mobil platform exhibited by land birds as they crossed the Gulf of Mexico (Table 1). Five species (three land birds and two seabirds) were not observed on the Mobil platform but were instead observed over one of the three submerged banks.

Synthesis.—All avian species reported here are known to occur in the northwestern Gulf Coast region at some point during the year. The species list is not complete; there are many species occurring in the region yet to be recorded at the Sanctuary. For example, Peake et al. (1996) list an additional 15 seabird species observed in the Gulf of Mexico, beyond those recorded in the Sanctuary. While we know that many passerines migrate across the expanse of the Gulf of Mexico between their winter and breeding habitats, we do not yet have a comprehensive list of the species conducting trans-Gulf migrations. Records reported here are the product of opportunistic observations, and a systematic sampling effort is needed to reveal more species of seabirds and neotropical migratory land birds occurring in the Sanctuary.

Avian species recorded at the Sanctuary probably occur in the region as a result of seasonal migrations (whether these be true or nomadic) over the northwestern Gulf of Mexico, seasonal ranging (to expand feeding habitat), and the accidental displacement of coastal species (that may be driven offshore by inclement weather advancing from the north or that are arbitrarily following a seagoing vessel). All land bird species should be considered transient species to the Sanctuary, although some species may seasonally reside along the northwestern Gulf Coast. Within the Sanctuary, seabirds forage in the waters over the submerged banks and around the Mobil platform, while migrating neotropical migratory land birds take advantage of available freshwater and food resources found on various platforms. Table 3 summarizes the habitat use, ecological guilds, and processes leading to these patterns.

Both land and sea birds rest, roost, or refuge on available platforms (boats, buoys, or rig). Resting, roosting, and refuging on the Mobil platform by neotropical migratory land birds accounts for most of the avian species recorded in the Sanctuary. Offshore platforms, such

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TABLE 3. Summary of avian guilds occurring within the Flower Garden Banks National Marine Sanctuary, probable ecological processes leading to their presence in the region, and habitat use demonstrated by the respective guilds. Offshore platforms include the Mobil High-Island A389A production platform, various boats, and buoys. Most resting, roosting, and refuging documented for birds took place on the Mobil platform.

Ecological guilds	Ecological processes	Habitat use
Neotropical migratory land birds	Seasonal migrations (trans-Gulf/ circum-Gulf)	Resting, refuging, roosting, foraging at offshore platforms
Northwestern Gulf Coast residents	Accidental displacement	Resting, refuging, roosting, foraging at offshore platforms (land birds) or surrounding waters (seabirds)
Neotropical seabirds	Seasonal ranging and dispersal to expand foraging area	Resting, refuging, roosting, foraging at offshore platforms and surrounding waters
Transequatorial seabirds	Seasonal migrations, ranging, and dispersals to expand foraging area	Foraging in waters over banks and around offshore platforms

as the Mobil platform, may be characterized as steel islands, providing birds occurring in the offshore environment with sites at which to feed, drink, roost, rest, and refuge. While the presence of birds at offshore platforms may be transitory in nature, these steel islands nonetheless function as a habitat, as is evident in the described accounts.

CONSERVATION ISSUES AND FUTURE RESEARCH DIRECTIONS

Endangered species.—I consider the occurrence of the lone brown pelican unusual and accidental, because this species traditionally remains in the more coastal waters of the region. Yet, the presence of the Peregrine falcon on the platform deserves further consideration. Although this was the only individual of this species observed on the Mobil platform, conversation with offshore platform personnel revealed similar accounts of Peregrine falcons and other raptors, including owls, which were seen foraging from other platforms off the Texas–Louisiana coast (Quinton Ballentine, Robert Cintron, John Reeves et al., pers. comm.). Observations of Peregrine falcons foraging from offshore platforms on migrating passerines indicate that this strategy may be another factor in the recovery of this species. Many birds perish during their migrations across the expanse of the Gulf of Mexico, as is evident from the number of passerine carcasses found on the Mobil platform during the spring migratory period. Falcons and other raptors may improve their chances of completing trans-Gulf migrations by stopping to forage on the migrating neotropical passerines that are also using offshore platforms. Differential mortality among neotropical migratory land birds (passerines vs raptors) conducting trans-Gulf migrations deserves further investigation, particularly for endangered species such as the Peregrine falcon.

Neotropical land bird migrants and their use of offshore platforms.—In an eloquent missive, John Terborgh (1989) elucidated the plight of neotropical migratory birds. These birds face continued pressure in the temperate regions of North America while also suffering the loss of winter habitats in the neotropics because of agricultural and urban development. Although these are not the only factors leading to decreasing avian populations (including that of many wood warbler species), they nonetheless are significant.

As part of any conservation plan for migratory species, migratory stopover areas must be included, in addition to migratory endpoint areas (Myers et al., 1987). The role that offshore platforms play as refuging or stopover areas for neotropical land bird migrants conducting trans-Gulf migrations requires additional research. Studies contrasting avian use of steel islands versus natural islands may prove valuable to the field of avian ecology and to future conservation efforts.

Further, scientists must answer the question of whether offshore platforms increase or decrease the mortality of birds conducting trans-Gulf migrations. It is premature to conclude

from my observations that offshore platforms are responsible for the mortality of passerines. In fact, I believe these steel islands may contribute to the survival of some individual birds and to the demise of other individuals, depending on a plethora of factors, including the physiological state of each individual, species dynamics (e.g., predation by raptors), and the environmental conditions the birds currently encounter and are likely to encounter during the remainder of their migrations.

Additionally, scientists and managers should consider how platforms may be influencing the migratory corridors of neotropical land birds. If platform use is shown to increase the survival of neotropical migratory land birds, then placement of platforms in coastal, offshore, and oceanic waters may permit some traditionally circum-Gulf migrants to shift their migratory corridors farther out into the Gulf of Mexico by "platform hopping" and may potentially decrease the overall distance a bird might migrate. Further research related to this issue should consider the trend of placing offshore platforms in oceanic waters as platforms in coastal and offshore waters near the end of their production lives. Removal of these coastal platforms is inevitable, and how their removal might affect neotropical land bird migrant populations may be important to the success of a management plan. At the least, offshore rigs in the northwestern Gulf of Mexico may be used by scientists to effectively delimit trans-Gulf and circum-Gulf migratory corridors.

Seabird conservation.—Aside from the brown pelican, seabirds visiting the Flower Garden Banks live a rather inconspicuous existence. Apart from offshore personnel, few people are aware that these birds exist in the Gulf. It is apparent that these seabirds benefit from the presence of people working offshore; fishermen make otherwise unavailable food resources (bycatch) available or platforms provide a refuge from offshore storms or sites on which to periodically roost. While there is little to suggest that negative anthropogenic pressures on regional seabird populations exist, seabirds inhabiting other regions of the world's oceans do suffer from human activities. Use of offshore structures by seabirds merits more attention as a potential means to mitigate seabird mortality in some regions of the world.

Habitat conservation for wide-ranging species.—Effective conservation of wide-ranging species requires an understanding of the different habitats utilized by migratory populations and of the corridors through which they move between habitats. Many conservation plans currently do not incorporate all habitats (links) utilized by the migratory species that they are designed to recover. The "habitat chain" is weakened at points where the weakest links (unprotected/nonmanaged areas) occur. As should be evident from the number of land birds occurring within the Sanctuary and over the Gulf of Mexico, offshore human activities can affect the avian populations (transient species, specifically) that inhabit lands as far north as Canada or as far south as Brazil. Negative offshore activities may disrupt the ecological balance of neotropical or boreal forest communities, whereas positive activities may enhance the recovery of recently or presently threatened populations (i.e., Peregrine falcons). Therefore, management of marine areas may be important in the conservation or recovery of many North American migratory bird populations that may occur within the region, however briefly. Information regarding the spatial and temporal ecology of all wide-ranging faunal groups occurring within protected areas is necessary in order to ensure wise management decisions that will likely affect ecosystems far outside of those protected areas.

The Sanctuary is a refuge for many species beyond the coral reef community that it was originally established to protect. While manta rays (*Manta birostris*) glide below the ocean's surface amidst the tropical corals and reef fishes, swallows, falcons, terns, and boobies ply the aeolian currents above the Sanctuary waters. Further consideration to avifauna occurring in the offshore environment of the Gulf of Mexico merits the attention of marine resource users, managers, and biologists, as these wide-ranging species contribute to the quality of ecological health in areas well beyond the northwestern Gulf of Mexico.

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